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Review Article on Hypertension

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INTRODUCTION

Systemic arterial hypertension (hereafter referred to as hypertension) is characterized by persistently high blood pressure (BP) in the systemic arteries. BP is commonly expressed as the ratio of the systolic BP (that is, the pressure that the blood exerts on the arterial walls when the heart contracts) and the diastolic BP (the pressure when the heart relaxes). The BP thresholds that define hypertension depend on the measurement method. Several aetiologies can underlie hypertension. The majority (90–95%) of patients have a highly heterogeneous 'essential' or primary hypertension with a multifactorial gene-environment aetiology. A positive family history is a frequent occurrence in patients with hypertension, with the heritability (a measure of how much of the variation in a trait is due to variation in genetic factors) estimated between 35% and 50% in the majority of studies. Genome-wide association studies (GWAS) have identified ~120 loci that are associated with BP regulation and together explain 3.5% of the trait variance These findings are becoming increasingly important as we search for new pathways and new biomarkers to develop more-modern 'omics'-driven diagnostic and therapeutic modalities for hypertension in the era of precision medicine.

Hypertension is another name for high blood pressure. It can lead to severe health complications and increase the risk of heart disease, stroke, and sometimes death.

Blood pressure is the force that a person's blood exerts against the walls of their blood vessels. This pressure depends on the resistance of the blood vessels and how hard the heart has to work.

Almost half of all adults in the United States have high blood pressure, but many are not aware of this fact.

Hypertension is a primary risk factor for cardiovascular disease, including stroke, heart attack, heart failure, and aneurysm. Keeping blood pressure under control is vital for preserving health and reducing the risk of these dangerous conditions.

In this article, we explain why blood pressure can increase, how to monitor it, and ways to keep it within a normal range.

Definitions of hypertension based on the 2013 ESH/ESC guidelines

Category	**Subtype**	**Systolic BP (mmHg)**	**Diastolic BP (mmHg)**
Office BP	NA	≥ 140	≥ 90
Ambulatory BP	Daytime (awake)	≥ 135	≥ 85
	Night time (asleep)	≥ 120	≥ 70

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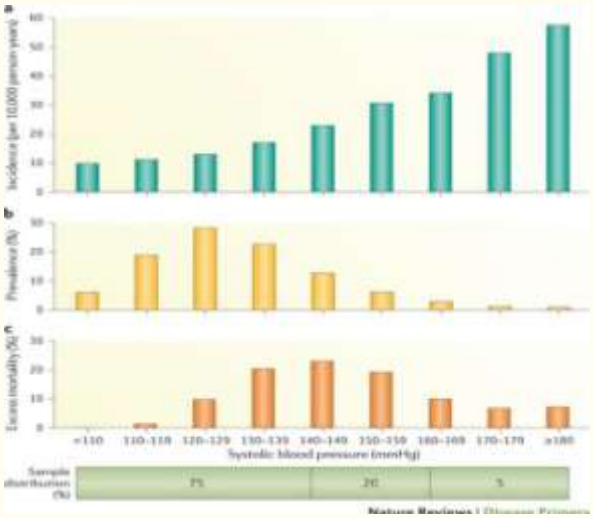
Category	Subtype	Systolic BP (mmHg)	Diastolic BP (mmHg)
	24hr	≥ 130	≥ 80
Home BP	NA	≥ 135	≥ 85



remaining disease burden could be attributed to the approximately 20% of adults who had a systolic BP in the high-normal range (systolic BP 130–139 mmHg)
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In individuals of 40–69 years of age, a 20 mmHg rise of systolic BP or a 10 mmHg rise of diastolic BP regardless of baseline values is associated with more than a doubling of the risk for stroke or ischaemic heart disease mortality[17], whereas a systolic BP reduction of 5 mmHg can decrease stroke mortality by 14% and CVD mortality by 9%. At older ages (≥80 years), the corresponding relative risk is slightly lower, but the absolute risk is far greater than earlier in life[17]. For example, a 20 mm Hg difference in systolic BP between 120 and 140 mmHg is associated with an annual difference in absolute risk that is nearly ten times larger at ages 80–89 years than that at ages 50–59 years.

MECHANISMS/PATHOPHYSIOLOGY

BP regulation

BP is determined by several parameters of the cardiovascular system, including blood volume and cardiac output (the amount of blood pumped by the heart per minute) as well as the balance of arterial tone that is affected by both intravascular volume and neurohumoral systems (discussed in the following sections). The maintenance of physiological BP levels involves a complex interplay of various elements of an integrated neurohumoral system that includes the renin-angiotensin-aldosterone system (RAAS), the role of natriuretic peptides and the endothelium, the sympathetic nervous system (SNS) and the immune

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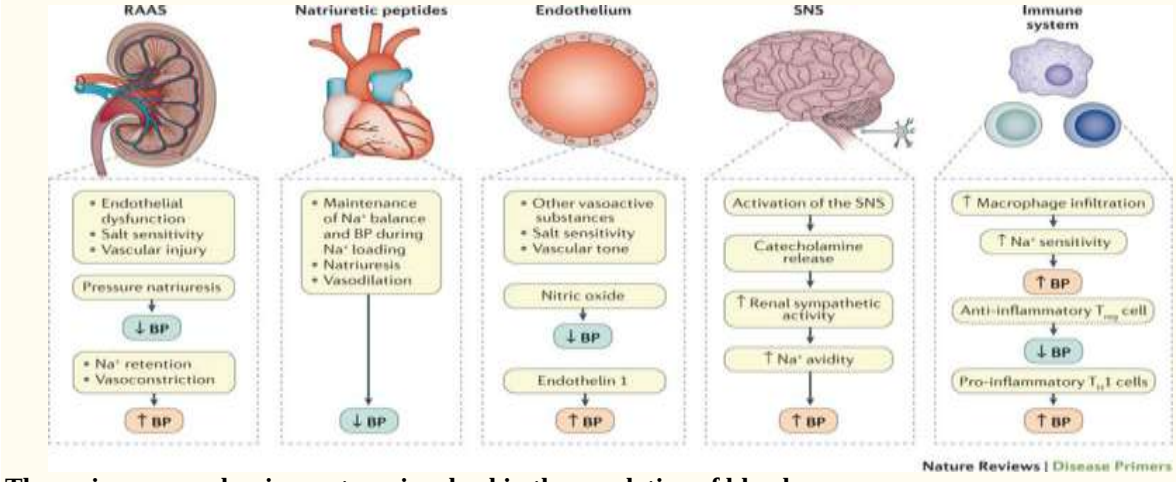
system. Malfunction or disruption of factors involved in BP control in any of these systems can directly or indirectly lead to increases in means.



The main neuroendocrine systems involved in the regulation of blood pressure.

DIAGNOSIS, SCREENING AND PREVENTION

Diagnosis and screening

Essential or primary hypertension is usually asymptomatic; thus, in clinical practice all adults should have their BP measured at regular office visits. Hypertension is most commonly diagnosed based on repeated BP measurements in a clinical office setting. Accurate measurement and recording of BP is essential to categorize the level of BP, ascertain BP-related CVD risk and guide management. Since 2010, methods to measure out-of-office BP have been increasingly introduced to guide diagnosis and treatment of hypertension. These include home BP monitoring (HBPM) and ambulatory BP monitoring (ABPM).

Diagnosis

The evaluation of a patient with hypertension requires more than the diagnosis of elevated BP. It should also include assessment of the CVD risk, target organ damage, and concomitant clinical conditions that may affect the BP or related target organ damage as well as recognition of features suggestive of secondary hypertension. Some of these investigations are routine tests necessary examination, and routine tests. In rare inherited forms of hypertension, a single gene mutation explains the pathogenesis of hypertension. A small proportion of patients have a potentially reversible cause of hypertension, and a correct diagnosis might lead to a cure or a substantial improvement in BP control with a reduction of CVD risk. It is therefore appropriate to implement a simple screening for secondary hypertension in all patients. The screening is based on clinical history, physical examination and routine laboratory investigations.

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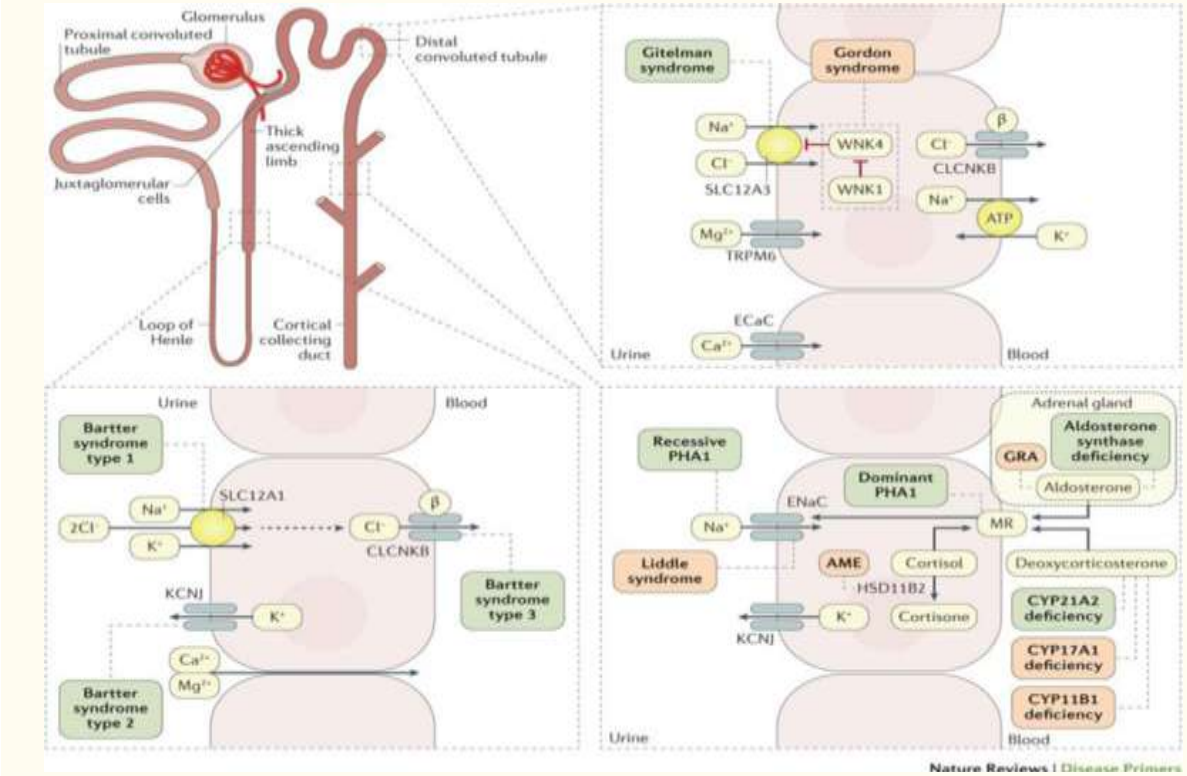
PATHWAYS HYPERTENSION AND HYPOTENSION SYNDROME



Pathways affected in single gene, Mendelian hypertension and hypotension syndromes

Management and treatment

Lifestyle adjustments are the standard, first-line treatment for hypertension. We outline some recommendations here:

Regular physical exercise

People can measure blood pressure using a sphygmomanometer.

Current guidelines recommend that all people, including those with hypertension, engage in at least 150 minutes of moderate intensity, aerobic exercise every week, or 75 minutes a week of high intensity exercise.

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Stress reduction

Avoiding or learning to manage stress can help a person control blood pressure.

Meditation, warm baths, yoga, and simply going on long walks are relaxation techniques that can help relieve stress.

People should avoid consuming alcohol, recreational drugs, tobacco, and junk food to cope with stress, as these can contribute to elevated blood pressure and the complications of hypertension.

Smoking can increase blood pressure. Avoiding or quitting smoking reduces the risk of hypertension, serious heart conditions, and other health issues.

Medication

People can use specific medications to treat hypertension. Doctors will often recommend a low dose at first. Antihypertensive medications will usually only have minor side effects.

Eventually, people with hypertension will need to combine two or more drugs to manage their blood pressure.

Medications for hypertension include:

- diuretics, including thiazides, chlorthalidone, and indapamide
- beta-blockers and alpha-blockers
- calcium-channel blockers
- central agonists
- peripheral adrenergic inhibitor
- vasodilators
- angiotensin-converting enzyme (ACE) inhibitors
- angiotensin receptor blockers

Angiotensin-converting enzyme inhibitors and angiotensin II receptor blockers.

Among medications that inhibit components of the RAAS, ACE inhibitors and angiotensin II receptor blockers are considered first line antihypertensives, whereas other antihypertensive medications targeting RAAS, including direct renin inhibitors and mineralocorticoid receptor antagonists, are usually considered reserve medications because there is less clinical trial evidence supporting their use as first line antihypertensive therapy. ACE inhibitors and angiotensin II receptor blockers have been tested extensively in large-scale hypertension trials. In patients with heart failure with reduced left ventricular ejection fraction or with diabetic nephropathy, both drug classes improved outcomes, making them particularly good choices in these populations. Both classes appear to be comparable in reducing CVD risk.

Dihydropyridine calcium channel blockers.

Dihydropyridine calcium channel blockers elicit vasodilation by blocking vascular smooth muscle L-type calcium channels. They are effective antihypertensive drugs with extensive experience in large clinical trials. A practical advantage of this drug class is that it can be combined with all other first-line antihypertensives. Peripheral edema, which is explained by peripheral arterial vasodilation rather than worsening heart failure or kidney dysfunction, is a common side effect, particularly in individuals with obesity. Non-dihydropyridine calcium channel blockers, especially verapamil, also inhibit cardiac calcium channels, which can reduce heart rate and cardiac contractility[1]

Thiazide-type and thiazide-like diuretics.

Thiazide-type diuretics (for example, hydrochlorothiazide) have a benzothiadiazine ring, whereas thiazide-like diuretics (for example, chlorthalidone, metolazone and indapamide) lack the benzothiadiazine structure. Both subclasses of thiazide diuretics inhibit Na^+ and Cl^- co-transporters in renal tubules, thereby promoting natriuresis, and have been an important component of pharmacological hypertension management ever since the first trials showing morbidity benefits of antihypertensive therapy. Over the years, diuretic doses have been substantially reduced to attain better risk-benefit profiles. Thiazide-type and thiazide-like diuretics can worsen glucose metabolism increasing the risk for new onset diabetes mellitus, but whether or not this metabolic action translates into long-term increases in CVD risk has been called into question.

Beta-adrenoreceptor blockers.

Beta-adrenoreceptor blockers lower BP reducing cardiac output, heart rate, renin release and adrenergic control nervous system effects. They improve outcomes following acute myocardial infarction and in patients with heart failure with reduced left ventricular ejection fraction, but, in the absence of these comorbidities, beta-adrenoreceptor blockers are inferior to other first line antihypertensives in reducing CVD morbidity and mortality. This effect has been attributed to lesser reductions in aortic BPand adverse effects on body weight and glucose metabolism with beta-adrenoreceptor blockade. Some of these disadvantages might be mitigated with newer vasodilator beta-adrenoreceptor

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blockers, such as sinus node rate or atrioventricular conduction.

Reducing salt intake

People's average salt intake is between 9 grams (g) and 12 g per day in most countries around the world.

The World Health Organization (WHO) recommend reducing intake to under 5 gTrusted Source a day to help decrease the risk of hypertension and related health problems.

Instead, experts recommend:

- whole grain, high fiber foods
- a variety of fruit and vegetables
- beans, pulses, and nuts
- fish rich in omega-3 twice a week
- nontropical vegetable oils, for example, olive oil
- skinless poultry and fish
- low fat dairy products

Managing body weight

Excess body weight can contribute to hypertension. A fall in blood pressure usually follows weight loss, as the heart does not have to work so hard to pump blood around the body.

The DASH diet

(NHLBI) recommend the DASH dietTrusted Source for people with high blood pressure. DASH stands for "Dietary Approaches to Stop Hypertension."

- lowers high blood pressure
- improves levels of fats in the bloodstream
- reduces the risk of cardiovascular disease

Research from 2014 suggests that using probiotic supplements for 8 weeks or more may benefit people with hypertension.

Causes

Share on PinterestStress can increase the risk of high blood pressure.

Primary hypertension can result from multiple factors, including:

- blood plasma volume
- hormone activity in people who manage blood volume and pressure using medication
- environmental factors, such as stress and lack of exercise
- diabetes, due to kidney problems and nerve damage
- kidney disease
- pheochromocytoma, a rare cancer of an adrenal gland
- Cushing syndrome that corticosteroid drugs can cause
- congenital adrenal hyperplasia, a disorder of the cortisol-secreting adrenal glands
- hyperthyroidism, or an overactive thyroid gland
- hyperparathyroidism, which affects calcium and phosphorous levels
- pregnancy
- sleep apnea
- obesity

Poorly managed stress and a family history of high blood pressure can also contribute to the risk of developing hypertension.

Below is a 3-D model of hypertension, which is fully interactive.

Explore the model using your mouse pad or touchscreen to understand more about hypertension.

Complications

Long term hypertension can cause complications through atherosclerosis where plaque

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develops on the walls of blood vessels, causing them to narrow.

This narrowing makes hypertension worse, as the heart must pump harder to circulate the blood.

Hypertension-related atherosclerosis can lead to:

- heart failure and heart attacks
- aneurysm, or abnormal bulge in the wall of an artery that can burst
- kidney failure
- stroke
- amputation
- hypertensive retinopathies in the eye, which can lead to blindness

The systolic reading of 130 mmHg refers to the pressure as the heart pumps blood around the body. The diastolic reading of 80 mmHg refers to the pressure as the heart relaxes and refills with blood.

The AHA 2017 guidelines define the following ranges of blood pressure:

	Systolic (mmHg)	**Diastolic (mmHg)**
Normal blood pressure	Less than 120	Less than 80
Elevated	Between 120 and 129	Less than 80
Stage 1 hypertension	Between 130 and 139	Between 80 and 89
Stage 2 hypertension	At least 140	At least 90
Hypertensive crisis	Over 180	Over 120

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